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垣曲盆地一新的细齿兽(食肉目,细齿兽科)化石[1)]

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摘要 记述了在山西省垣曲县亳清河右岸火石坡发现的细齿兽一新种——亳清河细齿兽?(*Miacis? boqinghensis* sp. nov.)。新种与细齿兽属所有已知种不同在于上臼齿具发育的前、后小尖,且小尖均具明显的前、后棱。

关键词 山西垣曲,中始新世,细齿兽科

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山西垣曲盆地是我国始新世哺乳动物化石研究的发祥地。早在1916年,安特生(J.G. Andersson)在垣曲县古城镇寨里村附近找到始新世哺乳动物化石。后经师丹斯基(O. Zdansky)进一步采集和研究,垣曲盆地的始新世哺乳类很快引起国内外学术界的广泛注意。我国著名的古生物学家杨钟健、李悦年、周明镇等也先后进行过野外采集和化石研究。此后,垣曲盆地始新世地层和哺乳动物化石的研究工作一直在进行中。

从1994年起,为抢救小浪底水库淹没区珍贵的哺乳动物化石,中美两国古生物工作者在山西省垣曲盆地进行了连续的考察工作,除在已知化石点发掘找到大量珍贵的化石(Beard *et al.*, 1996)外,还发现了许多新的化石点,垣曲县王茅乡郭家村火石坡就是其中的一个。1998年我们在该点进行了较长时间的发掘,所获颇丰,采集的化石多是带牙齿的上、下颌骨,其中包括啮齿类、兔形类、食虫类、食肉类、奇蹄类和偶蹄类。灵长类标本是在室内镜下发现的,因为我们在野外除采集标本外,还筛洗了一部分样品。

我国在新生代各个地质时期,尤其在始新世发现了大量的哺乳动物化石,但食肉动物并不多,特别是细齿兽化石,以往只在4个地点发现过不多的标本。因此,每一块化石的发现都是十分珍贵的。本文即是在该地点发现的珍贵的细齿兽化石的研究报告。

食肉目 Carnivora Bowdich, 1821

犬形亚目 Caniformia Kretzoi, 1945

细齿兽科 Miacidae Cope, 1880

细齿兽属 *Miacis* Cope, 1872

亳清河细齿兽?(新种) *Miacis? boqinghensis* sp. nov.

(图版I)

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正模 一左上颌骨带颊齿 P3～M2(IVPP V 11697)。

地点与层位 山西省垣曲县王茅乡郭家庄西火石坡，中始新世河堤组底部化石层。

特征 P4 原尖中等大小，前附尖很小。M1 前附尖突出在牙齿的前外角；前小尖发育，具明显的前、后棱；后小尖较小，也有清楚的前、后棱；内侧齿带异常发育，在后内角齿带进一步加强。M2 不很退化，前附尖向外突出，后小尖显小，前、后小尖均有弱的前、后棱，内齿带完全。

词义 亳清河，黄河在山西境内的支流，化石产地火石坡即位于亳清河的右岸。

描述 左上颌骨上存留 4 个上颊齿，除 M1 外侧稍有破损外，其余牙齿均完美无缺。上齿列外侧明显向外凸，最凸处位于 P4 和 M1 之间。而 4 个牙齿的内侧基本上排列成一条直线。

P3 小，双齿根，冠面近卵圆形，长大于宽。前尖(主尖)高大，略呈扁圆锥状，前后径较长。前尖基部占据牙齿冠面的绝大部分。齿带几乎围绕整个牙齿的四周，仅在外侧中部和前内侧较弱，但在前内侧有小而清楚的齿带突起。除前侧齿带发育外，牙齿的后内部齿带较宽，似初始的跟座。前尖的后基部向牙齿后部伸出一短而弱的纵脊。后跟尖小或不明显。

P4 为典型的裂齿。呈不规则的三角形——三角形三边由前壁、外壁和后内壁组成，其中前壁稍短，后内壁明显拉长。前壁和外壁中间均凹入，后内壁较平直。前尖(主尖)最高大，角锥状，顶端稍向后倾，和 P3 一样位置近于牙齿中间。前尖向原尖伸出的脊弱而不明显，向后伸向裂凹的脊近于上下垂直，向前外角伸向前附尖的脊也比较陡峻。原尖中等大小，比前尖低得多，位于牙齿前内角。前附尖比原尖小，位置也略低，象是由牙齿前外角的齿带形成。后附尖叶高而锐利，其高度仅略低于前尖，呈前内后外向直线状，两壁微凸。前尖与后附尖之间有一明显而深的裂凹。P4 最大的剪切面为前尖—后附尖叶。和 P3 一样，低而弱的齿带围绕牙齿四周，仅在原尖内侧中断。和牙齿冠面形状一致，前齿带和外齿带中部均凹入，而后内齿带较平直。

M1 略呈长方形，内壁收缩，横宽。前尖稍破损，角锥状，向前外方伸向前附尖的脊明显。后尖也破损，故与前尖的关系不清楚。原尖新月形，位置比在 P4 中高得多。原尖前脊和原尖后脊均很发育，分别伸向前附尖的前基部和后尖的后基部。原尖前脊较直，原尖后脊略向后凸。前小尖强大，也呈新月状，前、后棱明显，前小尖的后棱短，伸向前尖的后内侧基部。后小尖比前小尖略小，较远离原尖，形态与前小尖相似，也有清楚的前、后棱，后小尖前棱短，伸向后尖的前内基部。原凹较深。前附尖大，突出在牙齿的前外角。无后附尖和次尖。前、后、内齿带异常发育，围成大半个圆形，分别终止于前尖和后尖基部，但在原尖后内侧相当于次尖的位置上比较宽高。

M2 小而退化，呈斜的长方形，横宽，前缘平直，后缘微凹，外缘较斜，内缘浑圆。前尖较大，三角锥状。从前尖顶端伸向前外的脊比较长，直达前附尖的前侧。前尖内侧垂直向下伸的脊短而不明显。前尖后脊从顶端向后延伸与后尖前脊以一明显的裂凹相隔。后尖比前尖小得多，也略低，位于前尖的后侧，由于外壁呈前外后内向，所以比前尖靠近唇侧。原尖的形状与在 M1 中的相似，只是小(与小的 M2 成比例)。原尖后脊先向后外然后急转向外弯曲明显。前小尖和后小尖的状况也与在 M1 中的相似。亦无次尖。前附尖大，

突出在牙齿的前外角，在位置上比三个主尖低。后附尖无或不明显。前、后齿带在牙齿外半部不发育，在内半部与内齿带连成一连续的半圆。外齿带低但清楚，外架中等大小。与 M1 一样，在原尖后内侧相当于次尖的位置齿带比较宽高。

表1　强大细齿兽的上颊齿(V 11697)测量

Table 1 Measurements of the upper dentition (V 11697) of *Miacis? boqinghensis* sp. nov. (mm)

		P3	P4	M1	M2	P3～M2	P3～P4	M1～M2
长(L.)	外缘(e.m.)	5.3	6.9	5.2	3.3	19.2	12.9	8.9
	后内缘(p.i.m.)		9.2					
宽(W.)	前缘(a.m.)	2.7	5.2	7.8	5.2			
	后缘(p.m.)			7.0*	4.4			

* 为近似值　L.=length W.=width e.m.=external margin p.i.m.=posterointernal margin a.m.=anterior margin p.m.= posterior margin

比较与讨论　上述牙齿，尺寸不大，P4 发育成裂齿，上臼齿基本上属尖形齿。M2 不延长，虽未保存 M3，但从 M2 相对较大、后缘不收缩、次尖部位的齿带仍有膨大看不象是最后的上臼齿，因此当属食肉类细齿兽科(Miacidae)。Miacidae(MacIntyre, 1966)有人翻译成麦牙西兽科(郑家坚等，1975)，*Miacis* 被译成小古猫(周明镇，1975)，但人们通常使用细齿兽科、细齿兽(徐余瑄等，1979；童永生等，1986；齐陶等，1991)。在这个科中，本文材料最接近细齿兽属(*Miacis*)的已知种。

Miacis 属是由 Cope 于 1872 年创建。模式种为 *M. parvivorus*，标本是只带一颗 m2 的破碎的下颌骨(AMNH 5019)(Matthew, 1909)。在北美，至今已有 16 个种归入该属(Flynn, 1998)，最早出现于 Wasatchian 早期(始新世早期)，延续到 Chadronian 早期(始新世晚期)，是北美始新世地层中最常见的食肉动物。北美的 10 多个种在牙齿形态上的差异早已引起学者的关注，Matthew (1909) 曾将当时的 7 个种分成 4 组，但终究难以区分未被采用，甚至他本人也未再使用(Matthew, 1915)。这就是我们暂将亳清河种归入 *Miacis* 属的原因。

在北美的已知种中，就 M1 和 M2 的前附尖形态看可分为两个类型，一是前附尖相对发育，明显地向前外方突出，使牙齿前缘宽度远大于后缘部分，牙齿前后部分不对称。这一类型包括模式种、*M. washakius* 等大部分已知种。另一类型是前附尖不如前一类型的各种发育，使牙齿前后部分显得比较对称，Gustafson(1986) 记述的两个种可作为这一类型的代表。本文记述的上臼齿形态则与前一类型接近。

M1 内侧齿带发育程度在北美已知种中也不一样，可分为几个类型。模式种(*M. parvivorus*) 内齿带不包围原尖，但后内侧齿带有次尖(Matthew, 1909)，而像 *M. deutschi* 的细齿兽，齿带弱，次尖也小。另一类细齿兽的 M1 内齿带包围原尖，次尖无或很退化，如 *M. medius* 和 *M. hargeri*。*M. exiguus* 的 M1 内齿带与之相近，但后内侧齿带增强。*M. cognitus* 和 *M. australis* 的 M1 内齿带向舌侧增宽，与北美的其他细齿兽不同。亳清河种 M1 的内齿带围绕原尖，并在后内侧增强，与 *M. exiguus* 相似，但比后者强得多。

亳清河种另一个特点是小尖相当发育，M1 的前小尖具前、后棱，后小尖也有前、后棱。在 M2 上小尖同样发育，也具前、后棱。这在归入 *Miacis* 属的已知种中都未出现过，因此怀疑亳清河种归入 *Miacis* 属是否合适。

欧洲也将始新世某些食肉类归入 *Miacis*，但 Mathis(1985) 认为始新世晚期的 *Miacis exilis* 应从 *Miacis* 属中分离出来，另立新属。并怀疑欧洲标本，特别是 Quercy 和 Robiac 的标本归入 *Miacis* 是否恰当。欧洲种 P4 前附尖退化，M1 内齿带很发育，围绕牙齿舌侧部分，次尖退化或缺失。这些特点与亳清河标本相近，但与亳清河标本不同的是 M1 前附尖不如亳清河种那样向外突出，前小尖无后棱，后小尖弱，内侧齿带虽很发育，但前内侧齿带和后内侧齿带似不如亳清河种强。

在亚洲，目前只在我国发现过细齿兽化石。最早，Matthew 和 Granger(1925)记述了内蒙古伊尔丁曼哈层发现的一颗左 M1(AMNH 20137)，订名为强大细齿兽(*Miacis invictus*)。郑家坚等(1975)根据在江西新喻宁家山采集到的上、下颊齿建立了细巧新喻兽(*Yinyuictis tenuis*)，但 Gingerich(1983)认为新喻兽是细齿兽的同义词。我国第三个细齿兽种是由周明镇于1975年命名的，他根据产自河南省卢氏盆地王家坡的一段带有 p2～m2 的右下颌骨 (V 4811)建立了卢氏种(*Miacis lushiensis*)。先后归入这个种的有河南李官桥盆地核桃园和江苏溧阳的标本(周明镇等，1973；徐余瑄等，1979；童永生和雷奕振，1986；齐陶等，1991)。亳清河种完全可以同上述的标本相区别。亳清河种的牙齿明显地比细巧新喻兽大，其大小与其他的中始新世细齿兽相近。亳清河种 M1 异常发育的内侧齿带和具有前、后棱的前小尖和后小尖容易与已知的标本相区别。

先后归入 *Miacis* 属有 20 多种，*Miacis* 包含的种多，形态差异也大，引起学者的关注。Flynn(1998)明确指出，*Miacis* 有可能是并系 (paraphyletic)。其实早在20世纪初，Matthew(1909)将 *Miacis* 属分为或许可认为是亚属的 4 个类型。欧洲学者(Mathis, 1985)则将归入 *Miacis* 属的欧洲种，根据 m1 齿高和齿长之比另立一新属——*Paramiacis*。其实某些归入 *Miacis* 属的北美种是否合适的确值得探讨。产于得克萨斯 Chadronian 期的 *Miacis cognitus* 和 *M. australis* 与属的模式种(*M. parvivorus*)有相当大的区别。得州种 M1 前附尖不大向外突出，使牙齿的前、后部分显得比较对称，内齿带向舌侧突出，使牙齿显得比较横宽等。由于这些明显区别的存在，将得州标本归入 *Miacis* 属是很难让人信服的，如果另立一属似乎不是不可以。

郑家坚等(1975)所建的细巧新喻兽(*Xinyuictis tenuis*)，Gingerich(1983)将其归入 *Miacis* 属，并与他新建的 *M. winkleri* 对比。其实，新喻兽有一些容易与 *Miacis* 模式种(*M. parvivorus*)相区别的特点，如新喻兽的 M1 具有较强的外齿带，中间突起，形似柱尖，围绕原尖的前齿带和后齿带虽清楚但相当弱，并无次尖等。在 *Miacis* 的已知种中未见像新喻兽如此发育的外齿带，其围绕原尖的内侧齿带虽像 *M. deutschi* 那样低弱，但无次尖。上面已经提到 *Miacis* 已知种在牙齿形态上差异很大，很可能是并系，在这种背景下，认为新喻兽是细齿兽的同义词看来还需重新考虑。

食肉类的历史可追逆到第三纪初，自从 Cope 建立了 Miacidae 后，大家一直把这个科当作原始食肉类的基干类型，几乎所有的古新世和始新世早、中期的食肉动物都归入这一科。虽然对 Miacidae 科的复杂性有所认识，但也限于将这个科分成两个亚科：Miacinae 和 Viverravinae，或者在 Miacoidea 超科之下成独立的两个科。近年来分支分类系统学的兴起，对早期食肉动物的分类问题也给予一定的关注。Flynn 和Galiano(1982)率先将早期食肉类分别归入猫形亚目(Feliformia Kretzoi, 1945)和犬形亚目(Caniformia Kretzoi, 1945)，

进一步将原来归入古灵猫亚科(Viverravinae)或古灵猫科(Viverravidae)的几个属分别归入他们创建的 Didymictida 下目(infraorder)和 Aeluroida 下目，将原归入细齿兽亚科或细齿兽科的属归入犬形亚目。由于早期食肉类的复杂性，这个分类系统未被接受。在 Flynn 的最近文章中，只将早期食肉类笼统地分置在猫形亚目和犬形亚目，不进行细分。的确，早期食肉类与现生种类的关系有待于理顺，与第三纪初期出现的肉食性动物——肉齿目(Creodonta)之间的系统关系也需进一步研究。但目前，除北美有较多的早期食肉类标本外，其他大陆材料不多，妨碍了对早期食肉类的了解，而亳清河标本的发现更说明了早期食肉动物的复杂性。

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A NEW *MIACIS* (MAMMALIA, CARNIVORA, MIACIDAE) FROM THE MIDDLE EOCENE OF YUANQU BASIN, SHANXI PROVINCE

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Key words　Yuanqu, Shanxi, Middle Eocene, Miacidae

Summary

The Chinese and American scientists have not only collected many mammalian fossils at known fossil localities but also found several new localities in Yuanqu Basin since 1994. Huoshipo, near Guojia Village, Wangmao Town is the most important one among those new localities, where we found several dozens of jaws and teeth representing Insectivora, Lagomorpha, Rodentia, Carnivora, Primates, Perissodactyla and Artiodactyla in the spring of 1998. The present paper dealt only with carnivorous fossil, which is the best upper jaw and dentation of *Miacis* so far found in China.

Carnivora Bowdich, 1821

Caniformia Kretzoi, 1945

Miacidae Cope, 1880

***Miacis* Cope, 1872**

***Miacis? boqinghensis* sp. nov.**

(pl.I)

Type　A left maxilla with P3～M2 (IVPP V 11697).

Locality and age　Huoshipo near Guojia Village, Wangmo Town, Yuanqu County,

Shanxi Province; Middle Eocene.

Diagnosis P4 parastyle small, protocone medium-sized. M1 parastyle projects on the anteroexternal corner of the tooth. Paraconule more developed, with pronounced pre-and postparaconule crista. Metaconule is small, but also with distinct pre-and postmetaconule crista. Internal cingulum strong, especially in the posterointernal side. M2 not too reduced, similar to M1 morphologically but small in size.

Etymology Boqinghe, a tributary of Yellow River, the fossil was found nearby.

Description All four upper cheek teeth are well-preserved except M1, which was somewhat damaged at the posteroexternal corner. The upper tooth row is convex outwards between P4 and M1, however, the inner margin of the tooth row is rather straight.

P3 is small, oval in shape and longer than wide. The paracone (main cusp) is large and high, nearly cone-like with long dimension anteroposteriorly, occupying most base part of the crown. Cingulum surrounded margins of the tooth only weak at middle parts of the external and anterointernal sides. Apart from more developed anterior cingulum, the posterointernal one is long and wide, like rudimental talon, with a short and weak longitudinal crest in the middle.

P4 is a typical carnassial, irregular triangular in outline, consisting of anterior, external and posterointernal walls. The anterior wall is short while the posterointernal one is rather long and straight. Both anterior and external walls are concave at the middle. The paracone is large and high, cone-like, and somewhat curved backward at the tip. It situates in the central part of the tooth as in P3. The protocone situating near the anterior part of internal wall, is moderate in size, and much lower than the paracone. The crest extending from the paracone to protocone is weak but distinct, to the carnassial notch is nearly vertical, and to the parastyle is steep. The parastyle is smaller and lower than protocone, and nearly merged into the cingulum. The metastyle lobe is high and sharp, anterointernaly-posteroexternaly directed. There is a deep carnassial notch between paracone and metastyle lobe. As in P3, the low and weak cingulum surrounds the tooth, concaving in the middle parts of both anterior and external walls in accordance with the shape of the tooth.

M1 is somewhat transversely rectangular in outline, with short internal wall. The paracone is partly damaged, and has distinct crest extending to the parastyle. The metacone is damaged completely. The protocone is crescent, much higher than that in P3 in position. Both preprotoloph and postprotoloph are well developed, extending to the anterior base of parastyle and posterior base of metacone respectively. The preprotoloph is rather straight while the postprotoloph is somewhat convex backward. The paraconule is strong, also crescent in shape, with a short crest extending towards the posterior part of internal wall of paracone. The metaconule is similar to paraconule

in shape, but smaller and relatively far away from protocone than the latter, with a short crest going towards anterior part of internal wall of the metacone. The parastyle is better developed, distinctly situated at the anteroexternal corner of the tooth. There are no metastyle and hypocone. Semicircular cingulum occupis the inner half of the tooth and terminates at the base of parastyle and metacone respectively. The cingulum is strong at the posterointernal side of the protocone, somewhat resembles hypocone-shelf.

M2 is oblique rectangular in outline, smaller than M1. It has flat anterior, somewhat concave posterior, oblique external and relatively rounded internal margins. The paracone is large, cone-like. The crest extended from the paracone to the anterior side of parastyle is long, and the one to metacone is cut by a distinct carnassial notch. The metacone is lower and much smaller than the paracone, situating posterior to paracone but near the external wall of the tooth owing to anteroexternal -posterointernally obliqued labial wall. The protocone resembles that in M1 but smaller. The preprotoloph is relatively straight. The postprotoloph extends posteroexternally first then outwards distinctly. Both paraconule and metaconule are as developed as in M1. The parastyle is relatively large, distinct on the anteroexternal corner, lower than the three main cusps. There are no metastyle and hypocone. The stylar shelf is moderately broad. The cingulum is similar to that in M1.

Comparison and discussion Judging from the tooth morphology and size, especially the carnassial P4, and that M2 is transversely wide with relatively long posterior wall and somewhat hypocone-shelf-like which may indicate the animal has M3, the Yuanqu specimen should belong to Miacidae of Carnivora. In this family the material under study is most similar to *Miacis*.

The genus *Miacis* was created by Cope in 1872. The type (AMNH 5019) of the generic species *M. parvivorus* is a fragmentary lower jaw only with m2 on it. In North America there are about 16 species so far known (Flynn, 1998), ranging in age from early Wasatchian to early Chadronian, being the most common carnivorous animals in the North American Eocene strata. The difference of tooth morphology among these species is very complex. Matthew (1909) divided them into four groups, but this division was not accepted by later workers, including hemself (Matthew, 1915), for it is very difficult to distinguish. So we tentatively identified Yuanqu specimen as *Miacis*, with question mark after.

According to the parastyle morphology of M1 and M2, known North American *Miacis* can be divided into two groups: 1) Upper molars possess more developed parastyle, which distinctly projects towards anteroexternal corner, making anterior width much wider than the posterior one, and are asymmetrical in tooth outline. This group contains most of known species, including *M. washakius* and generic species. 2)

Upper molars are symmetrical in shape with undeveloped parastyle. The representatives of this group are the two species described by Gustafson (1986). Our specimen resembles the first group in this character.

The degree of internal cingulum in M1 is very different in North Amerian known species. *M. parvivorus* has internal cingulum disconnected at the inner side of the protocone but with hypocone (Matthew, 1909). *M. deutschi* possesses weak internal cingulum and small hypocone. In *M. medius* and *M. hargeri* the internal cingulum continues in the inner side of the protocone but has no hypocone. The internal cingulum in *M. exiguus* is similar to that both in *M. medius* and in *M. hargeri,* but is very strong in the posterointernal corner. The internal cingulum in *M. cognitus* and in *M. australis* broadens lingually, different from other North American species. The internal cingulum in Yuanqu specimen continues at the inner side of the protocone, and is much stronger in the posterointernal corner, which somewhat resembles that in *M. exiguus.*

Some European Eocene carnivores were attributed to Miacidae in the past. But recently Mathis (1985) considered *Miacis exilis* should be out of *Miacis* and be a new genus. He further doubted that some European specimens, especially those came from Quercy and Robiac, belong to *Miacis*. Yuanqu new *Miacis* resembles European species in reduced parastyle on P4, more developed internal cingulum which surounds protocone, and without hypocone; but differs mainly in projected parastyle on M1, having postparaconule crista and stronger metaconule, and much stronger internal, especially posterointernal cingulum.

In Asia, Miacidae fossils only found in China. Matthew and Granger (1925) created a new species, *Miacis invictus* based on an isolated left M1(AMNH 20137) from the Irdin Manha Bed, Nei Mongol. Based on the upper and lower cheek teeth found from Ningjiashan, Xinyu County, Jiangxi Province, Zheng *et al.* (1975) established a new genus and species-*Xinyuictis tenuis*. Gingerich (1983) considered *X. tenuis* was synonym of *Miacis,* but we think the generic name may still be available. Chow (1975) created another species, *Miacis lushiensis*. The type is a right lower jaw with p2～m2 found from Lushi Basin, Henan Province. After then, specimens found from Liguanqiao Basin, Henan Province and Liyang County, Jiangsu Province were assigned to *M. lushiensis* (Xu *et al.*, 1979; Tong and Lei, 1986; Qi *et al.*, 1991). Yuanqu specimen is much bigger in size than that of *Xinyuictis tenuis*. In Yuanqu specimen the more developed internal cingulum and distinct pre–and postcrista of both paraconule and metaconule on M1 and M2 can be distinguished from all known *Miacis* species in China.

Miacis is very complex and may be paraphyletic as suggested by Flynn (1998).

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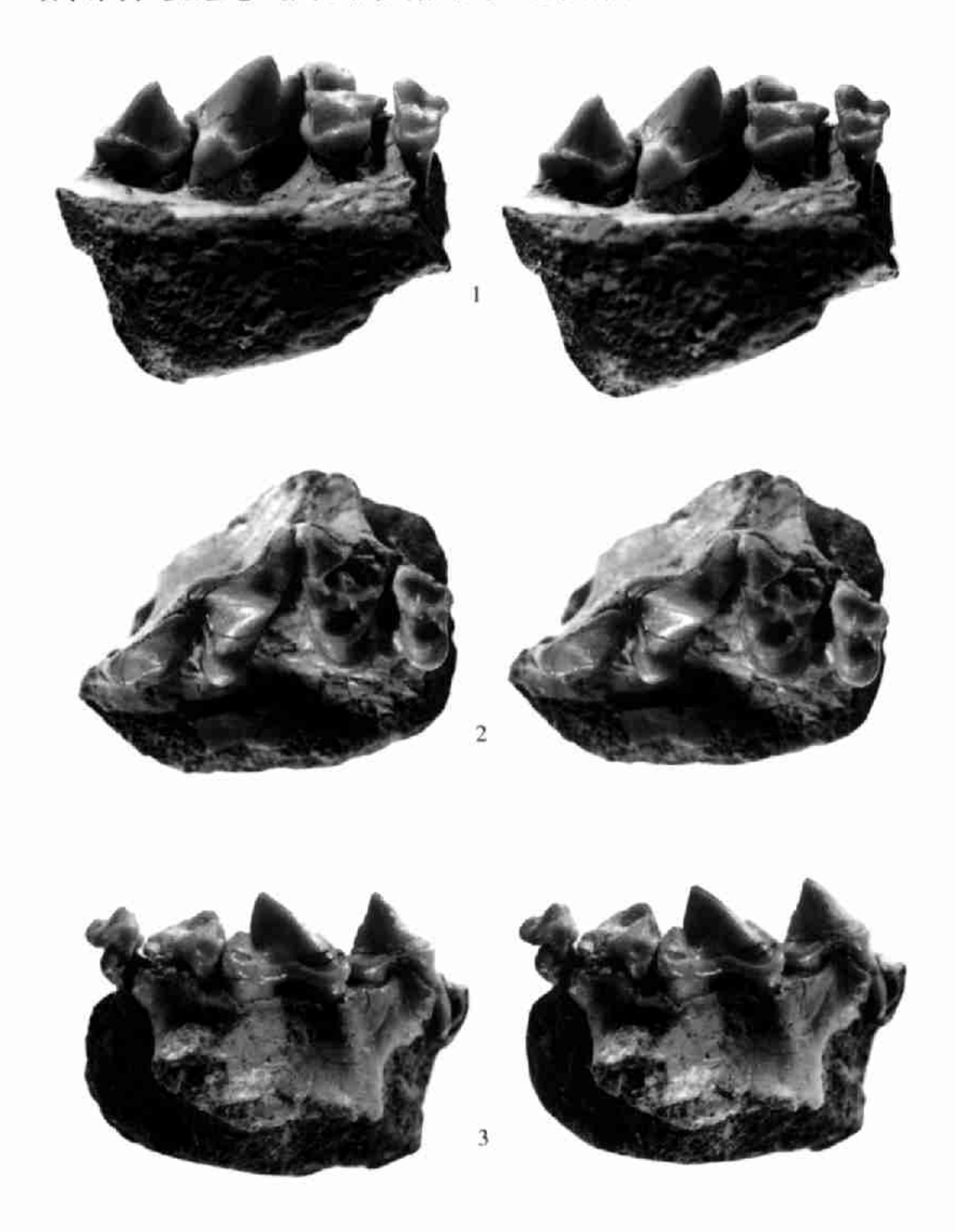
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图版 I 说明 (Explanations of Plate I)

亳清河细齿兽? (*Miacis? boqinghensis* sp. nov.) 的左上颌骨 (left maxilla) 附颊齿 P3～M2 (V 11697), ×3

1 舌面观 (lingual view), 2 冠面观 (crown view), 3 唇面观 (Labial view)



1

2

3